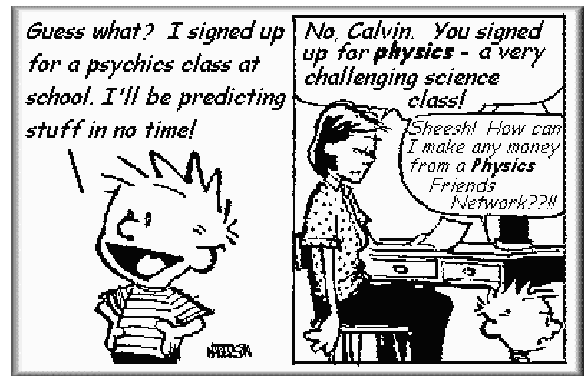


Welcome to Physics 106!

Pick up a copy of the syllabus
And the electronic clicker on the desk

I hope learning physics is
what you are here for!



Not much of a chance of making money with a
Physics Friends Network!

Physics 106 Spring 2005 General Info

- **Costas Soukoulis** (soukouli@iastate.edu)
office: A519 phone: 4-2816
- Office hours: Tuesday and Thursday 9 -10 am
and by appointment
- Course web site
<http://cmp.ameslab.gov/physics106/>
will have syllabus, lecture notes, homework and
solutions, general info on recitations and labs
- Check also the [Phys106 bulletin board](#)

Where I am coming from?



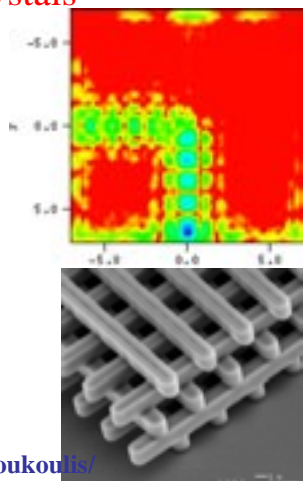
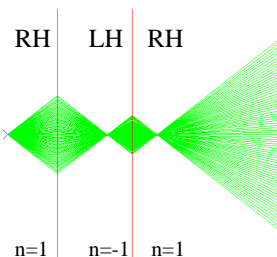
My short bio

- I was born in Corinth, **Greece**.
- I did my **doctoral** work in
Theoretical Condensed Matter
Physics at **University of Chicago**
Chicago, Illinois.
- I came to Iowa State University
in 1984 after working at
University of Virginia and
Exxon Research and Eng.
Company.



My favorite research projects: LHMs and Photonic Crystals

Focusing in a LHM



<http://cmpweb.ameslab.gov/personnel/soukoulis/>

Course Philosophy

- The **purpose** of this course is to promote a **deeper understanding** of conceptual **physics**, and **science** and nature in general.
- We will always **emphasize physical ideas** rather than mathematics, although a basic level of mathematics and some quantitative thinking will be required.
- It is important to remember that **learning** is an **interactive process** and requires **effort** on the part of the student. New concepts are only absorbed after concentrated thought and **practice**.
- DO NOT BE AFRAID to ask questions in class or by email! My main purpose as the instructor is to help you learn.

Course Components

- Lecture**
 - main concepts, with interactive questions
- Lab**
 - reinforce concepts, practice with equipment
- Recitation**
 - problem-solving session
- Textbook**
 - background reading (most useful before lecture)
 - Examples provide problem-solving hints

Physics Learning Strategy

" I hear and I forget,
 I see and I remember,
 I do and I understand. "

– Confucius

- ◆ **Physics is like sports:**
it takes **practice** to improve
- ◆ Get help from me, the recitation instructors, help room and other 106 students

Assignments

- Two assignments each week (all the assignments are given to your course syllabus)
- Solutions to homework problems are discussed in the recitation session together with additional examples
- Assignments and Solutions will **posted on the bulletin board** and on the Web site
- Wed. recitation will also solve group exercises.
- Attendance will be taken in both recitations. (60 points)

Course Grade

Two Midterm Exams	200 points
Comprehensive Final Exam	200 points
Lab/prelab (must do all labs)	60 points
Recitation (attendance)	60 points
Homework (assignment & quizzes)	80 points

A 85-100% B 70-84% C 55-69% D 40-54%
F 40% or below

Flash Card Questions

$$(1/3) + (1/2) =$$

- A) 1/6 B) 1/5 C) 5/6 D) 3/5 E) 2/5

What is your height in meters?

- A) 10^{-2} B) 10^{-1} C) 10^0 D) 10^{+1} E) 10^{+2}

One inch is defined as 2.54 centimeters. The correct expression for a one-inch length, expressed in meters, is

- A. 2.54×10^2 meters. B. 2.54×10^1 meters.
C. 2.54×10^{-2} meters. D. 2.54×10^2 meters.

The Scientific Method

a method that is extremely effective in gaining, organizing and applying new knowledge

- Recognize a problem
- Make an educated guess -- a **hypothesis**
- Predict the consequences of the hypothesis
- Perform **experiments** to test **predictions**
- Formulate the simplest general rule that organizes the 3 ingredients into a **theory**

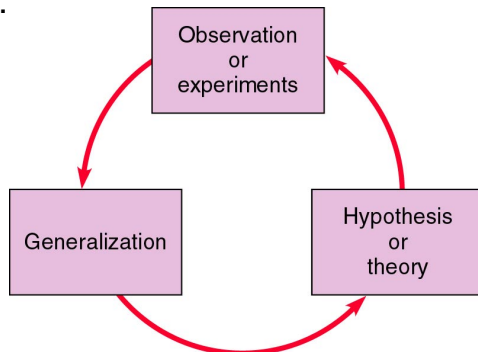
The theories of science are not fixed, but undergo change.
There is always a new experiment that can prove them wrong

This in contrast to some of the Greek philosophy;

Aristotle believed that the truth about the world could be obtained by "pure thought"

Scientific Method

The scientific method cycles back to observations or experiments as we seek to test our hypotheses or theories.



Science and Technology

What is Physics?

- Physics deals with the behavior and the composition of matter and its interactions at the most fundamental level.
- Physics is concerned with the nature of physical reality, that is, only with things that can be measured.
- Its domain stretches from inside the tiny nucleus of an atom to the vast expanses of the universe.
- Geology, chemistry, engineering, and astronomy all require an understanding of the principles of physics.
- Physics also finds many applications in biology, physiology and medicine.

That's why physics is the most basic science

Science and Religion are different from each other

Science is both a body of knowledge and a method of probing nature secrets

Religion has nothing to do with nature, but with meaning and its implications for personal and communal life.

The two complement rather than contradict each other.

Unless one has a shallow understanding of either or both, there is no contradiction in being religious and being scientific in one's thinking

Library of Alexandria burned in 390AD by religious fanatics

Galileo was prosecuted by the Vatican because he believed in the heliocentric theory

Numbers, powers of 10

- In physics, we often need to talk about very large and very small quantities.
- We need a notation which can express these numbers in a convenient notation
- The solution: **scientific notation**:

$$1200 = 1.2 \times 10^3$$

$$.000141 = 1.41 \times 10^{-4}$$

- To **multiply**, **add the exponents**

$$(3.2 \times 10^2)(2.0 \times 10^3) = (3.2 \times 2.0) \times 10^{(2+3)} = 6.4 \times 10^5$$

Numbers, powers of 10 (cont.)

- To **divide, subtract exponents**:
 $(3.2 \times 10^3) / (2.0 \times 10^2) = (3.2 / 2.0) \times 10^{(3-2)} = 1.6 \times 10^1$
- Significant figures**: The accuracy of a number is +/- 1 in the last digit quoted
 - If I say the temperature is 28.3 degrees F, I mean that the actual number is between 28.2 and 28.4.
 - If I say that a year is 3.1×10^7 seconds I mean that the actual number lies in the range $3.0 \times 10^7 - 3.2 \times 10^7$

Some Distances

Radius of Proton	1 E -15 m	Earth Radius	6 E 6 m
Radius of Atom	5 E -11 m	Distance to Pluto	6 E 12 m
Virus	1 E -8 m	Nearest Star	4 E 16 m
Thickness of Paper	1 E -4 m	Andromeda galaxy	2 E 22 m
Person	2 E 0 m	Farthest Quasar	2 E 26 m
Mt. Everest	1 E 4 m		

Converting Units

- Within the metric system, you can use various prefixes to indicate larger or smaller multiples of the basic units:
 - pico 10^{-12}
 - nano 10^{-9}
 - micro 10^{-6}
 - mili 10^{-3}
 - kilo 10^3
 - mega 10^6
 - giga 10^9
 - Tera 10^{12}

Metric System

- The basic physical quantities are: **Length, Time** and **Mass**
- In Science we use the metric system of units.
 - The unit of **length** is the **meter** (1 m = 3.28 ft)
 - The unit of **time** is the **second**
 - The unit of **mass** is the kilogram (1 kg weighs 2.2 lb)

Some Masses

Electron	9 E -31 kg	Elephant	5 E 3 kg
Proton	2 E -27 kg	Mountain	1 E 12 kg
Uranium atom	2 E -25 kg	Asteroid Eros	5 E 15 kg
Penicillin Molecule	5 E -17 kg	Moon	7 E 22 kg
Dust Grain	7 E -10 kg	Sun	2 E 30 kg
Grape	3 E -3 kg	Galaxy	2 E 41 kg
Person	1 E 2 kg	Universe	1 E 53 kg

The Mars Climate Orbiter Mission

- After Earth, Mars is the planet with the most hospitable climate in the solar system, NASA has many missions dedicated to Mars.
- Dec. 11, 1998 Climate Orbiter lifts off.
- September 19, 1999 first photo
- September 23, 1999 Mars Climate Orbiter arrives at Mars and fire its main engine to put itself into orbit around the planet. But Mars Climate Orbiter crashes.
- One of the engineering teams was using **English units** (inch, pound etc...) of measurement while another team was using **Metric units** (meters, kilograms)!

